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—— Un nouvel enregistreur de direction du vent. p. 239–240.

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Peppler, W. Zur Entstehung und Voraussage der Gewitter. p. 217–219.
Schulze, Paul. Ludwig Friedrich Kämtz. p. 219–224.
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Börnstein, R. Bericht abgestattet in der Hamburger Tagung der Deutschen Meteorologischen Gesellschaft. [Report on the public weather service of Germany.] p. 236–240.

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B., E. Wärmestrählung einer Schneedecke. p. 76.

Hemel en Dampkring. Den Haag. 6. Jaargang. November 1908.
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Alessandri, Cammillo. La radiazione solare alla Monte Rosa. Osservazioni eseguite alla Capanna-Osservatorio Regina Margherita negli 1905–1906. p. 58–65.

AN ANNOTATED BIBLIOGRAPHY OF EVAPORATION.

By MRS. GRACE J. LIVINGSTON. Dated Washington, D. C., January 8, 1908.

[*Continued from the Monthly Weather Review, September, 1908.*]

Miller, J. F.
Synopsis of meteorological observations made at Whitehaven, Cumberland, in the years 1848–50. Edinb. new phil. jour., 1848, (—): 55; 1849, (—): 53; 1851, (—): 234.
Includes observations on evaporation.

1852.

Newman, J.
Description of a new evaporating gage. Phil. mag., 1852, 4(4):534–5.
Describes an atmometer similar in design to that of Prinsep, 1825.

Regnault, V.
Études sur l'hygrométrie. Compt. rend., 1852, 35:930–9. Ann. chim. et phys., 1853, 37:257–85. Translated from Compt. rend. in Ann. Phys. und Chem., 1853, 88:420–32.
Repeats statements of 1845, and develops formulas for the psychrometer.

Tarbé.
Note sur la mesure de l'évaporation à la Roche-sur-Yonne, pendant les années 1846 à 1850. Ann. ponts chauss., 1852, 3:249–52. Abstracted by Rogers Field, 1869.
The evaporating basin employed in these experiments was made of masonry 8 feet 2¼ inches square and 1 foot 4 inches deep, and lined with zinc. Readings were taken once a month and the basin refilled to a standard level on a graduated scale fixt to one of the

inside faces. The evaporation from this basin was found to be nearly equal to the rainfall, thus confirming the results obtained by Vallés, and contrary to previous observations.

1853.

Aymard, Maurice.
Sur les irrigations de la Metidja et les cours d'eau de l'Atlas. Ann. ponts chauss., 1853, **6**:46–131.

Experiments to determine the effect of air movement upon evaporation gave a daily average of 0.000659 meter and 0.000471 meter for the check. The following comparable figures are quoted from de Gasparin's Cours d'agriculture, vol. 2, p. 306: 0.000437 meter per day at Orange; 0.000430 meter at Cavaillon; 0.000508 meter at Arles; 0.000400 meter at Marseilles· 0.000491 meter at Rome.

Clark.
On the amount of evaporation from two surfaces of water, each 9 square feet in area, the one under cover, the other open to the sky and on all sides; and the fall of rain received in a vessel of the same extent in the year 1852 in the Royal Arsenal at Woolwich. Athen., 1853 (—): 198.

The level of the evaporating surface is here observed by means of a float attached to a fine thread wound about a cylinder which is connected with an index hand moving over a dial. The dial is graduated in convenient units for measuring evaporation in terms of the subsidence of the evaporating surface. Another thread bearing a balancing weight is attached to the cylinder and is wound in the opposite direction. so that when the water surface rises, as during rain, the movement of the index is reversed. Results for the year show 10.3 inches evaporated from a water surface under a shed, and 25.8 inches from one freely exposed to the weather. The rainfall for the year was 31.8 inches, on 165 days.

Drian, Aimé.
Note sur l'évaporation négative. Ann. soc. agr. Lyon, 1853, **5**: 416–21.

Investigations show that when the temperature of the dew-point is higher than that of the evaporating surface atmospheric moisture is deposited upon that surface. This process is termed "negative evaporation."

Fournet, J.
Remarques sur "Note sur l'évaporation négative" par Aimé Drian. Ann. soc. mét., 1853, **1**: 234–7.

It is pointed out that whenever the temperature of the water in the evaporating dish is below that of the dew-point, while that of the air is higher, condensation instead of evaporation takes place. The most favorable season for observing this phenomenon is said to be in October, and a table of results obtained October 20–25 [1853?] is given. Observations with the condensation hygrometer, as well as with the thermometer, were found to run parallel to those of the evaporation. This paper also reviews the work of Vignon, 1853.

Marcet, Francois.
Recherches sur l'évaporation des liquides. Arch. sci. phys. et nat., 1853, **22**:305–28. Abstract by the author in Compt. rend. 1853, **36**:339–41. Also abstracts in "London Repertory of Patent Inventions," Jan., 1854; in Franklin inst. jour., 1854, **57**:278; Dingler's Polytech. Jour., **128**:51–2; and Zeits. f. Naturw., **1**:218–9. Translation from Bibl. univ., April, 1853, in Phil. mag., **6** (4):385–7; also Ann. Phys. und Chem., Ergänzungsband, **4**:345; Cosmos, 1853, **2**:358–9.

These researches were undertaken as the result of a letter by August de la Rive published in Comptes rendus for October, 1851. This letter explained former glaciation as due to the cold of evaporation experienced by recently formed land masses during the evaporation of the water which covered them This cold is supposed to have been very intense on account of the siliceous materials mingled with the water.

Marcet concludes from his experiments that: (1) The temperature of the evaporating surface is always lower than that of the atmosphere, the difference depending on the temperature of the latter. (2) The temperature and rate of evaporation of such liquids as water and alcohol vary according to the nature of the vessel in which they are contained. (3) The surfaces being identical, the mass or depth of the liquid seems, within certain limits, to favor evaporation. (4) A salt solution similar to sea water evaporates less rapidly than freshwater, consequently its temperature is lowered less by its evaporation. (5) Water mixt with sand so that a layer of water floats above the saturated sand, evaporates more than water alone and consequently becomes colder by evaporation, the difference in temperature rarely exceeding 0.5° C. The author concludes that his experiments tend to confirm the opinion of de la Rive concerning the cause of the appearances of ancient glaciers.

Vallés, F.
Nouvelles remarques sur la phénomène de l'évaporation naturelle. Ann. ponts chauss., 1853, **5**:269–80.

The author attempts to establish more firmly his statement of 1848, that the ratio of evaporation according to the seasons is 1: 2: 3: 1. This had been challenged by Charié-Marsaines, 1851, and Vallés finds so many conflicting numbers that he comes to no definite conclusion.

Vignon, E.
Notes sur des bassins d'évaporation employés dans la service du canal du Nivernais et de la rivière Yonne. Ann. soc. mét., 1853, **1**:36–40.

The atmometer used in this case was a cylindrical vessel 80 centimeters in diameter and 35 centimeters high. On one side, at 25 centimeters from the bottom, a vertical funnel connects with the interior, while on the other, at the same height, is attached a tube bearing a cock. The 25-centimeter level is marked on the inside by three vertical points. Water lost by evaporation is restored to this level thru the funnel from a graduated measuring dish, the diameter of which bears such a relation to that of the evaporating vessel that the reading is much magnified. If, owing to rain, the water rises above the 25-centimeter level, it can be drawn off by means of the cock until the three points just touch the surface of the water.

1854.

Gaugain, J.-M.
Note sur l'électricité qui accompagne l'évaporation de l'eau salée et sur l'origine de l'électricité atmosphèrique. Compt. rend., 1854, **38**:1012–15.

In experiments similar to those of Pouillet, 1837, using Volta's goldleaf electroscope and a marine salt solution, it was found that electricity is manifested exclusively during the decrepitation which succeeds the spheroidal state, the quiet evaporation which operates when the crackling has ceased never giving any sign of electricity. It was concluded, therefore, that atmospheric electricity can not be attributed to the chemical segregations which take place during the tranquil evaporation of the waters of the sea.

Gaugain, J.-M.
Sur le développement d'électricité qui accompagne l'évaporation des dissolutions aqueuses. Compt. rend., 1854, **39**:231.

Experiments with the electricity accompanying evaporation lead to a conclusion similar to Pouillet's, which ascribes the electricity to the friction between the evaporating liquid and the walls of the vessel.

Geddes, George.
Rain: evaporation and filtration. Trans. N. Y. State agr. soc, 1854, **14**:150–64.

In connection with a consideration of evaporation from soil, Henry Tracy, in a report to the Canal Board, 1849, p. 17 (?), is quoted as stating that the annual evaporation in 1835 from a surface of ground near Boston was 19.43 inches; in 1837, 14.95 inches; and in 1838, 21.49 inches; the rainfall for the same years being 35.26, 26.65, and 38.11 inches, respectively. Tables of evaporation from a water surface at Ogdensburg and Syracuse are also given.

1855.

Buist, George.
On the means of determining the actual amount of evaporation from the earth's surface. Met. soc. rpt., 1855 (—):6.

Chapman.
Object of the salt condition of the sea. Phil. mag., 1855, **9** (4):236–8.

Experiments showed that the evaporation from rain water exceeded that from a 2.6 per cent salt solution by 0.54 per cent for the first twenty-four hours, by 1.04 per cent after forty-eight hours, and by 1.46 per cent after seventy-two hours. Each experiment lasted six days and resulted in an always increasing ratio as the solution became more concentrated. It is considered that this fact points to the conclusion that the salt condition of the sea is a self-adjusting phenomenon mainly intended to regulate evaporation.

Drew, John.
Practical Meteorology. London. 1855. p. 30–2, 161.

The process of evaporation, its cooling effect, and the various methods of measuring the amount are discussed. Glaisher's tables are quoted from Phil. mag., 1848:1, to illustrate the diurnal range of the dew-point and of the temperature of evaporation as shown by the wet-bulb thermometer. From one daily observation of either the monthly mean may be deduced.

Jahn, G. A.
Handbuch der Witterungskunde. Leipsic. 1855. p. 107–10, 211–13.

Discussion of methods for determining evaporation and the conditions influencing it.

Meikle, Henry.
Evaporation. Encyc. Brit., 1855, 8th ed., **9**:496–515.

Presents historical sketch of various investigations of evaporation pursued by Desagulier-, Clement, Saussure, Deluc, Dalton, Desormes, Gay-Lussac, Halley, Dobson, Dalton and Hoyle, Daniell, Anderson, Meikle, etc.

Prestel, M. A. F.
Das Vaporimeter oder die Psychrometer-Skala, etc. Emden. 1855.

1856.

Blake, W. P.
On the rate of evaporation on the Tulare lakes of California. Amer. jour. sci.., 1856, **21**(2): 365–8.

The observed evaporation from a shallow pan, sheltered from the sun but exposed to wind, showed the yearly depth of evaporation in this region to be 7 feet, 7½ inches. A table gives the daily rate of evaporation, temperature of the air and water, with remarks on wind, etc., during the four days, August 26–9, 1853. It is concluded that evaporation from these lakes is equal to, if not greater than, the supply.

Coffin, James Henry.
Psychrometrical table: for determining the elastic force of aqueous vapor and the relative humidity of the atmosphere from indications of the wet- and dry-bulb thermometers, Fahrenheit. Washington. 1856. p. 20. Also in Smiths. misc. coll., etc. 1862, **1**.

Hopkins, T.
On certain arid countries and the cause of their dryness. Jour. roy. geog. soc., 1856, **26**: 158–73. Reviewed by Ramsey, 1884.

Treats of the rôle of vapors and their condensation in the movements of the atmosphere.

Mitchell, A.
Description of a new atmometer, or evaporometer. Jour. soc. arts, 1856, June 6. Also, London. 1856. 8vo.

Details of construction and diagrams are given of a constant-level apparatus for measuring evaporation, on the general principle of the fountain ink-stand or bird's drinking cup. The author holds that "the atmometer is a supplement to, not a substitute for the hygrometer."

Reischauer, C.
See Vogel, K. August, und C. Reischauer.

Vogel, K. August, und C. Reischauer.
Ueber ein Atmidometer neuer Construction. K. bayer. Akad. der Wiss. Munich, Gelehrte Anz., 1856, **42**: 15–6.

Two earlier forms of "atmidometer," the "atmidoscope" of Babinet and Newmann's evaporating gage are described. A new form consists of a balance bearing above one end of its beam a pan with the evaporating water, while a weight is suspended below. The other end bears a pointer, which shows on a dial the amount evaporated. This instrument has the advantage over the hygrometer that it can be left for a long time and will give the mean for the period, a result impossible to obtain with the latter unless it is read very often.

Way, J. Thomas.
On the composition of the waters of land-drainage and of rain. Jour. roy. agr. soc., 1856, **17**(1): 123–62.

Quotes Parkes, 1845, on results of Dickinson's experiments with evaporation from soil by means of the Dalton gage. Presents annual and monthly tables.

1857.

Sandeman, Patrick.
Monthly tables of daily means of meteorological elements during 11

years, commencing January, 1846, [at the] Observatory, Georgetown, Demerara, British Guiana. Greenock. 1857.

An account of intermittent observations of evaporation up to 1853, followed by columns of daily evaporation with monthly totals from January, 1853, to December, 1856. The rainfall and evaporation, in inches (?), for the respective months of 1856 is as follows:

	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Evaporation	4.017	4.668	5.172	4.025	2.740	2.305	2.052	1.840	3.069	3.071	2.604	2.360
Rainfall	2.019	0.963	1.655	3.055	10.232	16.705	13.230	7.806	5.804	3.145	5.776	17.336

1858.

Jenyns, Leonard.

Observations in meteorology (being chiefly the results of a meteorological journal kept for nineteen years at Swaffham Bulbeck in Cambridgeshire). London. 1858.

Discusses the effect of rainfall and humidity on the local climate, and the influence of moisture on sensible temperature. According to this author, dry weather in winter feels colder than moist. The conditions most favoring evaporation are heat, dry air, and diminished pressure on the evaporating surface. Howard's (1837) figures for daily evaporation are quoted. The relative humidity and dew-point are determined by means of Daniell's hygrometer.

1860.

Babington, Benjamin Guy.

On spontaneous evaporation. Review of a communication to the Royal Society, November 24, 1859. Phil. mag., 1860, 19(4):314–7. Reviewed in Fortschr. der Phys., 1859, 15:358–9.

Dissolved substances influence evaporation in various ways. The influence of different solutes may be estimated by comparing the rate of evaporation of their solutions with that of pure water. Evaporation is retarded in proportion to the quantity in solution, and does not depend on the specific gravity of the solution. In aqueous solutions of salts the retardation does not appear to depend upon the acid radical, altho it is not altogether independent of the influence of the base. With some exceptions, salts with two equivalents of an acid radical have greater retarding influence than those with one equivalent. Some salts in aqueous solution appear not to retard evaporation, and some seem actually to accelerate it.

Drew, John.

Practical Meteorology. (2d ed. edited by Frederic Drew.) London. 1860.

See Drew, 1855.

Mühry, A.

Allgemeine Geographische Meteorologie. Leipsic and Heidelberg. 1860.

On page 140 he gives a general discussion of evaporation as inflenced by humidity, seasons, time of day, and wind. Quotes Schübler's results of observations with a weighing atmometer (1826). Gives the results of Dalton's experiments showing the influence of higher temperature in increasing evaporation. Discusses geographic distribution of humidity which he regards as the most important factor influencing evaporation, especially where climates are compared.

The psychrometer is considered to be the real measure of the evaporating power of the air. Describes an atmometer similar to Lamont's (1868). It consists of a small open glass evaporator borne on a bent graduated tube which connects with a lower reservoir, the latter furnished with a second opening above closed by an air-tight cock. After filling the reservoir with water and noting the height on the scale, water is brought to the proper level in the evaporator by forcing air into the reservoir thru the upper opening and the cock is closed. After the instrument has been exposed to evaporation the cock is opened and when the water is again at the same level in reservoir and tube the change in position of the water surface on the scale of the tube shows the amount lost by evaporation.

The physiological and pathological effects of dry and moist climates enter into the discussion.

Ruinet.

Note sur l'évaporation. Ann. ponts. chauss., 1860, 20:150–60. Abstracted by Rogers Field, 1869.

Describes observations at Dijon from 1845–52, which show a continuation of the low rate of evaporation mentioned by Vallés (1850). This recent low rate is explained as due to the difference in the size and nature of the instruments by which the phenomenon had been observed. Small basins become unduly heated and cause a much higher rate than larger ones. Were similar instruments employed the rate from the Canal de Bourgogne would probably not be so different from rates elsewhere observed. It is concluded that "the evaporation which really takes place from the surface of a large natural extent of water is far from being as great as the observations on a small scale would lead one to suppose."

Schmid, Ernst Erhard.

Lehrbuch der Meteorologie. Leipsic. 1860. p. 595–600.

Quotes Dalton's tables, as reduced by Schübler to Parisian feet and inches, showing evaporation from a square foot of water surface in a quiet, previously dried atmosphere, at different temperatures during twenty-four hours. Tables compiled from Schübler's and Kämtz's results show the yearly evaporation at 26 stations in France, Germany, England, etc., and at Cumana. The rate of evaporation shows merely a general agreement with the average temperatures of the various places. Schübler's table of the daily evaporation in the shade at Tübingen, *is found to be of less value than that of Stark, who observed* the daily evaporation in the sunshine at Augsburg for fourteen years. The ratio obtained from the latter observations in the sun, is two or three times higher than that from the former in the shade.

An important factor influencing evaporation is shown to be the action of ascending air currents in accelerating the propagation of water vapor into the upper regions of the atmosphere. Schübler's tables showing the effect of wind, also the results of his experiments comparing evaporation from moist garden soil with that from water, are quoted. (Schübler, 1826, 1831; Kämtz, 1840.)

Schulze, Franz Eilhard.

Beobachtungen über Verdunstung im Sommer 1859. (Gekrönte Preisschrift.) Rostock. 1860. 4to.

Reviewed by Kämtz, 1862.

1861.

Mühry, A. A.

Ueber ein einfaches schärfer messendes Atmometer. Ann. Phys. und Chem. (Poggend.), 1861, 113:305–3.

The principal of measuring evaporation by reduction of surface, used by Newman and Prinsep, is more elaborately developed in this instrument which the author calls a microatmometer.

Reischauer, C. G.

Ueber die Abhängigkeit der Verdunstung von der Grösse der Exponirten Oberfläche. Ann. Phys. und Chem. (Poggend.), 1861, 114:177–86. Also, Zeits. f. Naturw., 19:331–2. Review in Fortschr. der Phys., 1861, 17:386.

Comparison of evaporation from water surfaces of different areas exposed for four days in a closed laboratory give the following results:

Surface	100	278	450	1905
Evaporation	100	260	448	1266

Unger, F.

Neue Untersuchungen über die Transpiration der Gewächse. Sitzber. k. Akad. Wiss. (Vienna), math. naturw. kl. 1861, 44:181–217, 327–68.

A comparison of transpiration with evaporation.

1862.

Beardmore, Nathaniel.

Manual of Hydrology. London. 1862. p. 296, 325, 332–5.

General discussion of the process of evaporation and the difficulties of measuring it. Cites the results of Howard, Daniell, Watson, etc. Gives the tables of A. Golding, state engineer at Copenhagen, showing evaporation from water at Endrup, from short grass and from long grass during the years 1849 to 1859. Table of monthly rainfall and evaporation for the ten years, 1844–1853, at Bolton-le-Moors, Lancashire, and at Whitehaven, Cumberland. Table of rainfall, evaporation, and temperature at Little Bridy, Dorset, and at Radcliffe Observatory, Oxford. Tables of tropical evaporation at Demarara or Georgetown, British Guiana, and at Bombay.

Herschel, Sir John F. W.

Meteorology. Encyc. Brit., 2d ed., Edinburgh. 1862.

For the evaporation of water, its rate at various temperatures, p. 50; of ice and snow, p. 125; accelerated by wind and other causes, p. 50 and 125; abstraction of heat by, p. 51; electricity developed by, p. 132.

He quotes the results of Pouillet, presented to the Academy of Sciences in 1825. From experiments on the problem of the electricity developed by evaporation he concludes that the simple change of state from the solid or liquid to the vaporous of any substance is unaccompanied by electrical excitement. The evaporation of pure water or of any other substance not decomposed or partly decomposed in the act, produces no electrical excitement whatever; but when evaporation is accompanied by chemical change electricity is developed. Water evaporated from alkaline solutions carries off "resinous" and leaves behind "vitreous" electricity. The reverse is the case when water evaporates from an acid, or from neutro-saline solutions, e. g., that of sea salt, or from heated iron which it oxidizes. His final conclusion is that the immense evaporation both from sea and land, and the vital processes going on, furnish at least the chief supply of electricity to the air.

Kämtz, L. F.

Ueber Verdunstung. Dorpat. 1862. 4to. Also Repert. f. Met., Dorpat, 1862, 2:200–3.

A general discussion of reasons for observing evaporation in the shade or in the sun, is followed by a review of the work of Schulze. The author in his own experiments to compare the rate of evaporation from pure water with that from various moist soils and from plants, used freely exposed glass vessels of equal height and surface, and the amount lost by evaporation was determined by weighing. From June 25 to the end of October the total evaporation from moist garden earth was 17.336 g., from saturated garden earth, 20.912 g., and from water, 16.448 g. Only in August was the rate from water higher than from moist soil. Saturated bog soil, with water-holding power of 170 per cent, lost 21.10 g. This excess of evaporation from the bog soil over that from water is explained by a probable small temperature difference in favor of the dark, opaque bog soil. The final conclusion is that, in general, soil covered with vegetation evaporates more than bare soil; and that the rate of evaporation from the Russian steppes is probably lower than it would be if they were covered with trees.

Krecke, —. —.

Het Klimaat von Nederland.

Gives the amount of evaporation for 1862 at Helder, Utrecht, Kniesdorp, and Oudorp. See H. W. Dove, 1864.

Lamont, Johann N.

Dalton's theory of vapor and its application to the aqueous vapor of the atmosphere. (Extr. from a letter by Lamont, dated Munich, Aug. 28, 1862, to Professor Kämtz at Dorpat), translation by W. T. Lynn, Phil. mag., 1862, 24:350–8. Reprinted in Proc. Brit. met. soc., 1863, 1:310–8.

Review of Dalton's (1801, 1802) theory regarding the mixture of vapor with the atmosphere. Lamont's experiments lead him to conclude that Dalton's theory, in so far as it assumes that the air and vapor existing in the same space are independent of each other, is unfounded and that in his opinion the facts are "that the air exerts a pressure upon the vapor and the vapor upon the air." The data furnished by the psychrometer are regarded as expressions of local humidity.

Mühry, A. A.

Klimatographische Uebersicht der Erde, in einer Sammlung authentischer Berichte mit hinzugefügten Anmerkungen zum wissenschaftlichen und practischen Gebräuche. Heidelberg. 1862.

A general discussion on p. 701–7.

Nowak, Alois.

Weltenweber—Mittheilungen aus einer grösseren hydrologischmeteorologischen Studien des Herrn Dr. Nowak über das Todte Meer und ihre Verdunstung. Sitzb. k. böhm. Ges. d. Wiss. (Prag), 1862 (pt. 1): 27–30.

This is a study of the inflow and evaporation from the Dead Sea, the former being 315 inches annually and the latter only 60 inches. The excess inflow is supposed to drain into a cavity between the crust and the center of the earth, to emerge later as springs or vapors.

Schmid, E. E.

Grundriss der Meteorologie. Leipsic. 1862. p. 125, 188–9.

Ocean currents are attributed to the action of rain and evaporation. Schübler's (1831) attempts to measure the evaporation from soil and plants are reviewed. Previous observations of this phenomenon are regarded as having only a very inferior value.

Tait, Prof. [Peter G.] and J. A. Wanklyn.
Note on the electricity developed during evaporation and during effervescence from chemical action. Reprinted in Phil. mag., 1862, **23**(4):494–6, from Proc. roy. soc. Edinb., February, 1862.

Experiments with evaporation of drops of water on hot metal plates, and the electricity accompanying the process, lead to conclusions in harmony with those of Gaugain, 1854.

Tate, Thomas.
Experimental researches on the laws of evaporation and absorption, with a description of a new evaporometer and absorbometer. Phil. mag., 1862, **23**(4):126–35, 283–9, 494; 1863, **25**(4):331–42. Synopsis by Cleveland Abbe, 1890.

The rate of evaporation is directly proportional to the difference in temperature indi cated by wet- and dry-bulb thermometers and the velocity of the wind, and inversely proportional to the pressure of the atmosphere. From damp porous substances of the same material it is proportional to the extent of the surface exposed without regard to the relative thickness of the substance. From different substances it depends on the roughness or inequalities on their surface, evaporation being greatest from roughest surfaces. From equal surfaces of the same material it is the same in quiet atmosphere whatever the inclination of the surface. A horizontal plate with the damp face upwards evaporates as much as with the damp face downwards. Rate of evaporation is influenced by the elevation above the ground, also by radiation from surrounding bodies,

Describes an atmometer consisting of an open cylindrical tank exposing a water surface of 80 square inches and having a bent tube leading from it supported at an inclination of 1 in 50. A fall of 1/50 inch in the water level in the cylinder will cause the water surface in the tube to move thru the space of 1 inch, thus magnifying the cylinder change by 50. The cylinder is also provided with a displacement gage which may be deprest until the water in the tube is again brought to the original position when the reading on the gage will give the number of cubic inches evaporated.

Wanklyn, J. A.
See Tait, Professor, and J. A. Wanklyn.

1863.

Airy, G. B.
Note on the theory of vapor pressure. Proc. Brit. met. soc., 1863, **1**:365–6.

Discussion of Dalton's laws and theories as attacked by Lamont, 1862.

Bloxham, John Charlton.
On the theory of vapor pressure. Proc. Brit. met. soc., 1863, **1**:362–5.

Further discussion of Dalton's theory of vapor pressure and laws governing it as attacked by Lamont, 1862.

Cornelius, C. L.
Meteorologie. Halle. 1863. p. 240–4.

Describes atmometers of Mühry, 1861; Babinet, 1848; Saussure, 1789; and the experiments of Marcet, 1853, and Schübler, 1826, 1830, 1831.

Nowak, A. F. P.
Hydrologisch-meteorologische Studie über das Kaspische Meer und die Verdunstung. Sitzber. k. böhm. Ges. d. Wiss. (Prag), 1863, **2** (pt. 2):13–23.

Gives calculations of the inflow and evaporation from the Caspian Sea similar to those made for the Dead Sea (Nowak, 1862). The excess of the inflow in this case is 33 cubic inches more than a German cubic mile.

Nowak, A. F. P.
Das Mittelländische Meer und der Ocean überhaupt gegenüber der Verdunstung. Lotos, 1863, **13**:116–20, 137–44, 155–60, 169–75.

The Mediterranean, like the Caspian and Dead Seas [Nowak, 1862 and 1863, (1)], receives much more water than evaporates from it. It is believed that since the excess can not flow out into the ocean at the surface nor by submarine currents it does so by underground channels.

Symons, G. J.
Evaporation. Brit. Rainf., 1863, (—):12.

Emphasizes the importance of improving the means of measuring evaporation from the earth's surface.

Vivenot, Rudolph von.
Ueber einen neuen Verdunstungsmesser und das bei Verdunstungsbeobachtungen mit demselben einzuschlagende Beobachtungsverfahren. Vienna. 1863. 8vo., p. 36. See also Repert. der Phys., 1866, **1**:203–30, and Sitzber. k. Akad. Wiss. (Vienna), Math. Naturw. Kl., 1863, **48**,(pt. 2):110.

A vertical, graduated tube leads from the under surface of the evaporating vessel and its enlarged free end plunges into a stationary vessel of mercury, a suitable mechanism providing for vertical movements of dish and tube. After the evaporating vessel and tube are filled with water to the desired level they are raised until the water surface stands at zero on the graduated tube, and the position of the mercury meniscus is noted by means of an ivory point attached to a scale. Vessel and tube are returned to their original position and the evaporation is allowed to proceed until a reading is desired, when they are once more raised until the mercury stands at the level previously noted. The water surface in the tube now stands somewhat below the zero on the graduated tube, and the reading on this scale indicates the amount lost by evaporation.

1864.

Cantoni, Giovanni.
Osservazioni su la evaporazione e la diffusione dei liquide, e su la imbibizione dei solidi porosi. Rend. r. ist. Lomb., 1864, **1**:183–95.

Dove, Heinrich Wilhelm.
Die Witterungserscheinungen des Nordlichen Deutschlands in Zeitraum von 1858–63. Berlin. 1864. 4to. p. 49–50. Also Preussische Statistik, No. 6. Berlin.

Quotes rates of evaporation for the years 1856–63, obtained by Gube (1864) at Zechen near Guhrau, Silesia. The rates for night, forenoon, afternoon, and the entire day are averaged by months and seasons. The average annual amount for these years was 16.239 inches. To this is added a table of observations by Dippe at Sülze (Beiträgen zur Statistik Mecklenburgs, vol. 2, pt. 2, p. 145), showing the daily mean rate for each month of the years 1856–60. The mean yearly amount at Sülze was 22.53 inches.

Temperature is regarded as very important in determining the evaporation rate. A final table is quoted from Krecke, 1862, containing the evaporation rates for 1862, in millimeters, at the four cities, Helder, Utrecht, Kniesdorp, and Oudorp. The lowest rate is 536 millimeters, for Helder, and the highest 807.6 millimeters, for Kniesdorp.

Grouven, A.
Meteorologische Beobachtungen nebst Beobachtungen über die freiwillige Wasserverdunstung und über die Wärme des Bodens in verschiedenen Tiefen im Jahre 1863 zu Salzmünde (bei Halle). Halle. 1864. 8vo.

Gube, Friedrich.
Die Ergebnisse der Verdunstung und des Niederschlages nach Messungen an neuen, zum Theil registirenden Instrumenten auf der königl. met. Station Zechen bei Guhrau. Mit einem Vorworte von H. Dove. Berlin. 1864. 8vo.

See Dove, 1864.

Prestel, Michael August Friedrich.
Die Aenderung des Wasserstandes der Flüsse und Ströme in der jährlichen Periode, als der jährlichen periodischen Zu- und Abnahme des atmosphärischen Niederschlags und der Verdunstung genau entsprechend an Beobachtungen nachgewiesen. Ber. Deut. Naturf., 1864, **39**:69–77. Also Zeits. Arch. Ver., 1864, **10**:col. 411–23.

It is here maintained that the rainfall, combined with the amount of evaporation, compares more closely with the curve of the river stages than does the rainfall curve alone. In support of this, tables and figures compare rainfall and evaporation at Emden, at Magdeburg on the Elbe, at Küstrin on the Oder, and at Frankfort on the Oder, with diagrams showing the curves of water supply of the respective rivers. Another diagram presents curves of yearly change in water-level of the Rhine at Basel, of the temperature on the St. Gothard, and of the ground-water at the foot of the Alps, showing that the yearly curve of the water-level at the headwaters of the Rhine follows very closely the temperature curves of the higher Alpine regions.

Prestel, Michael August Friedrich.
Ueber den Verdunstungsmesser (Atmidometer). Ber. Deut. Naturf., 1864, **39**:84–6. Also Ill. Zeitg., 1864, **43**:17.

This instrument is a simple constant-level apparatus, consisting of a cylindrical reservoir standing in a shallow, open pan. Water flows out of the reservoir when the level of the water in the pan is low enough to allow air to enter the former. (See Simmonds, 1867, and Prestel, below.)

Prestel, Michael August Friedrich.
Die Regenverhältnisse des Königreiches Hannover, nebst ausführlicher Darstellung aller den atmosphärischen Niederschlag und die Verdunstung betreffenden Grössen welche beim Wasserbau sowie beim rationellen Betriebe der Landwirtschaft in Betracht kommen. Emden. 1864. 4to. 1 ch., 2 pls.

A full description is given of the evaporation gage described in the preceding paper. Observations of evaporation at Zwanenburg, Utrecht, 1743–1841; and at Helder, Utrecht, and Dijon, 1853–62; the latter giving night and day rates with both and averages for each month, are tabulated. Another table brings together the maximum, minimum, and mean at Zwanenburg, Utrecht, Helder, and Dijon, averaging respectively for the year 591.07 mm., 321.55 mm., 601.44 mm., 601.04 mm. The monthly average for these places is added and a discussion of the relation between rainfall and evaporation follows.

Symons, G. J.
Evaporation. Brit. Rainf., 1864, (—).

A table presents rainfall and evaporation at different stations. Attention is drawn to the suspicious variations in the records, probably owing to the different methods of observing.

1865.

Fletcher, Isaac.
Remarks on the rainfall among the Cumberland Mountains, and on evaporation. Brit. Rainf., 1865 (—):20–2.

Includes a table of monthly evaporation measured by a gage similar to a rain gage.

Hildebrandsson, H. H., and P. G. Rosen.
Några undersökningar om det tryck, vattenången under afdunstning ut öfvar på den omgifvande luften. Öfvers. k. Svenska Vetensk. Akad. Förhandl., 1865, **21**:123–34.

Discussion of Dalton's laws in connection with investigations as to the pressure exerted on the surrounding air by water vapor during evaporation.

Prestel, M. A. F.
Der Verdunstungsmesser (Atmometer) in seiner einfachsten Form. Ber. Deut. Naturf., 1865, (—):101–3. Also Zeits. Oest. Ges. Met., 1866, **1**:192–4. Also translated by Simmonds, 1867.

The same instrument described in the author's paper of 1864.

Rosen, P. G., and H. H. Hildebrandsson.
See Hildebrandsson, 1865.

Tacchini, P.
Atmometro di Vivenot. Bul. met. oss., 1865, **1**(No. 4):2.

Description of Vivenot's (1863) atmometer.

Vaillant.
De l'influence des forêts sur le régime des sources. Les Mondes, 1865, **8**:674–9.

From the results of experiments with the transpiration from the branch of an oak tree it is estimated that a whole tree, about 21 meters high and 2.65 meters in circumference, would transpire, on a day in summer, more than 2,000 kilograms, or 2 cubic meters, of water. He concludes that the trees of a forested country cause it to have less [ground] water than it would possess if planted with cereals.

Vivenot, Rudolph von.
Sulla temperatura, ed umidita dell'aria e sulla evaporazione in Palermo osservazione meteorologiche. Palermo. 1865. Reprinted from La Sicilia.

1866.

Collin, A.

Atmidométrie. Recherches expérimentales sur l'évaporation. Mémoire couronnée par l'Academie des Sciences. Mém. soc. agr. Orléans, 1866. Also, Orléans. 1866. 8vo. Abstract in Compt. rend., 1864, 58:666. Also, Fortsch. f. Met., 1872, (—):211.

The object of this paper is to show the inaccuracy of a rule, attributed to Halley, according to which the evaporation from a mass of water bears the ratio 5:3 to the amount of rain and snow fallen in the same space and time. The memoir is based on nineteen series of observations, four lasting twenty years, the fifth ten years, the rest only from four to seven years. The observations were from five stations on the Canal of Burgundy, three on the Canal of the Marne, four on the Garonne, seven on the Canal of Nivernais. The evaporators exposed a surface of water more than six square meters in area. The maximum ratio between rainfall and evaporation was found to be 1.46 at Montréjeau and the minimum 0.54 at Gondrexanges. It is concluded that there is no uniform ratio between the two.

Dennis, W. C.

On surface evaporation. Ann. rept. Smithsn. inst., 1866, (—):402.

A letter to Professor Henry describes experiments conducted at Key West, Fla., which show that sea water evaporates slower than fresh water, and that the rate of evaporation of the former decreases as saturation is approached.

Felisch, J.

Was in der Luft vorgeht. Populäre Vorträge über Meteorologie. Berlin. 1866.

Pages 183-94 discuss the laws governing evaporation and its importance to vital phenomena.

Grouven, A.

Ueber das Verhältniss zwischen Wasserverdünstung und Regenfall und dessen agronomische Bedeutung. Allg. Land. Forstw. Zeitg., 1866, (—):16.

Home, D. Milne.

Letter of 2d April, 1866, to Alexander Buchan. Jour. Scot. met. soc., 1864-6, 1(n.s.):330.

Ramsay (1884) quotes this author as asserting that the rate of evaporation from bare or partially bare soil is higher than from soil well covered with grass; and higher from sandy loam than from clay.

Markham, C. R.

On the effects of the destruction of forests in the ghauts of India on the water supply. Jour. roy. geog. soc., 1866, 36:189.

The removal of forests is regarded as undoubtedly increasing evaporation and the rapidity of run-off, as may be seen in the hill districts of India where the floods caused by the monsoon rains are yearly increasing in size and violence.

Schenzl, Guido.

Ueber die Grösse der Verdunstung in Ofen. Zeits. Oest. Ges. Met., 1866, 1:177-81.

The extreme drought which had prevailed in Hungary led the author to investigate the rate of evaporation from water. Reischauer's (1856), Muhry's (1861), and Vivenot's (1863) atmometers and their studies of evaporation are reviewed. A simple apparatus, ascribed to Vivenot, consists of a pan with a tube and stop-cock below to allow the contents to be drawn off and measured. The water is measured at the beginning and end of the experiment, the difference less the amount of rain fallen in the meantime, is the amount evaporated.

Observations of evaporation, rainfall, and vapor pressure from June, 1863, to June, 1866, are tabulated. He finds no agreement between the rate of evaporation and the mean monthly temperature, since the wind enters as a factor in one case and not in the other. The evaporation for the three years was 2186.97 lines (Fr.), a yearly average of 60.75 inches; the total rainfall was only 566.77 lines (Fr.), yearly average, 15.74 inches. This difference is considered a sufficient explanation for the drying up of the Neusiedler See. From the above results the amount evaporated from the Platten See, 9.5 square miles in area, is estimated at not less than 63,269 million cubic feet for the three years.

Vivenot, Rudolph von.

Beiträge zur Kentniss der klimatischen Evaporationskraft und deren Beziehung zu Temperatur, Feuchtigkeit, Luftströmungen und Niederschlägen. Erlangen. 1866. 8vo.

A report on four independent sets of observations of evaporation made with the instrument described by Vivenot (1863). It is accompanied by tables and comparative curves of temperature, humidity, direction and velocity of wind, cloudiness, precipitation, etc. The stations were Eltville, on the Rhine, October 8 to December 12, 1861; Lilienfeld, in the Austrian Alps, October 13 to November 4, 1862; Vienna, September 1 to October 12, 1862; and Palermo, Sicily, November 16 to April 10, 1865.

The evaporation observations at Eltville are compared with those at Utrecht and Helder as recorded in 1861 by the Meteorological Institute of the Netherlands. The evaporation at Vienna is compared with observations by Sonklar, eight miles south of Vienna. These curves show no close agreement, the whole curve for the latter place being higher, due probably to a difference in the protection from wind. These comparisons lead to the general conclusion that it is necessary to have similar instruments similarly exposed to get comparable results.

Improvements on the instrument described in the previous article are detailed and tables for correcting the results obtained are added.

1867.

Buchan, Alexander.

A Handy Book of Meteorology. Edinburgh. 1st ed., 1867, p. 82-6; 2d ed., 1868, p. 145-167.

The process of evaporation is discussed in a general way (p. 82-86). Several instruments are described, viz, Mitchell's "evapometer," on the bird-fountain principle; Proctor's evaporometer, similar to Mitchell's but fitted with a diagonal scale; a Leslie atmometer, consisting of a graduated glass tube connected with a hollow, porous ball.

The loss of heat accompanying evaporation is touched upon, and evaporation from different soils is discust in some detail. Evaporation is said to be greater from the surface of loose earth than from a water surface, until the earth is so far dried as to be of a light color. By an experiment it was shown that evaporation from saturated moss greatly exceeds, on the first day, that from water; but on the second day the evaporation from water is in excess, and still more so on the third day, altho the moss is still wet ten inches below the surface. Quotes Home, 1866. It is pointed out that evaporation depends on the extent of the evaporating surface in contact with the air; but that as evaporation from soil proceeds, the rate is modified by the facility with which water is drawn by capillarity from the interior to the evaporating surface.

Cantoni, Giovanni.

Evaporimetre costrutto nell' officina "Tecnomasio italiano" di Milano. Met. ital. sup., 1867, (—):38-9.

A glass cylindrical evaporating vessel is fitted with a small adjustable cone, whose point indicates the standard level of the water. The whole is protected from rain by a metal shelter.

Haughton, Samuel.

On the evaporation of a water surface at St. Helena. (1864.) Proc. roy. Irish acad., 1867, 9:126-47.

Experiments carried on for two years with similar evaporators, one fully exposed, the other set in a large tub of water, showed a rate nearly 50 per cent higher from the former than from the latter.

Henry, D. F.

Table X, showing the evaporation and humidity for different winds at Milwaukee, for 1862-4. Also Tables Y and Z, showing temperature, humidity, and evaporation at Milwaukee, 1862-4. Rpt. Chf. Eng., 1867:599, 785-95.

From these tables it is concluded that evaporation is but slightly affected by the direction or velocity of the wind, that it is almost inversely proportional to the increase in humidity and directly proportional to the temperature.

Lyell, Sir Charles.

Principles of Geology. London. 1867. 10th ed. p. 286, 497.

Calls attention to the fact that dry winds evaporated snow very rapidly. The evaporation from some lakes is said to be equal to the quantity flowing in, notably in the Caspian (see Nowak, 1868). Lyell regards evaporation as a competent cause of oceanic currents, hence such currents might in some cases "afford valuable evidence as to the distribution of aqueous vapor."

Quoted by Ramsay, 1884.

Ragona, Domenico.

Sulle osservazioni eseguite nel R. Osservatorio di Modena. Met. ital. sup., 1867, (—):13-17. Also noticed in Zeits. Oest. Ges. Met., 1867, 2:380.

Evaporation measured by Vivenot's (1863) atmometer, as improved by the author, leads to the formula $E=12.711\text{mm.}+0.02623\text{ mm. }t-0.14869\text{ mm. }U$, in which t= the temperature of the air °C., and U= the relative humidity. The evaporation rate from a freely exposed surface was three or four times greater than from a Vivenot atmometer, the annual amount from the former being 3,468 millimeters; that from the latter, 940 millimeters. The rainfall for the same period was 567 millimeters. A table compares results from several different instruments. The rate of evaporation from several salt solutions is compared with that from pure water (see Hann, 1868).

Raulin, F. V.

De l'évaporation à Toulouse et dans le sud-ouest de la France. Rev. soc. sav., 1867, 1:155-64.

It is pointed out that "observations of evaporation should complement those of rain for the solution of a large number of questions relating to agriculture, to public works, and to industry." Tables present the evaporation at Poitiers (1789-91), Niort (1802-20), Saint Maurice and le Girard (1777-83), La Rochelle (1781-4), Bordeaux (1775-84, 1853-5, 1854-64), Cadillac (1856-64), Langon (1858-64), Agen (1857-64), Toulouse (1785-87, 1816-64), Rieux (1783-91?), and Montrejeau (1857-64). A comparison of evaporation and rainfall at Orange shows an excess of the former in the case of six instruments, and the opposite in the case of four others. Gasparin is referred to as stating that in Italy evaporation is almost double the rainfall, while at Rome and Lisbon it is almost triple. Recommends observations with vessels surrounded by large bodies of water.

Simmonds, G. Harvey.

Evaporation from rain-gages. Proc. Brit. met. soc., 1867, 3:326-8, 426-8.

The error due to evaporation is reported as small if the readings are made only once a month.

Simmonds, G. H.

The evaporation gage (atmometer) in its simplest form. Proc. Brit. met. soc., 1867, 3:337-9.

Translation of "Der Verdunstungsmesser (atmometer) in seiner einfachsten Form," by M. A. F. Prestel, 1865.

See Prestel, 1864, 2d title, for a description of this instrument.

Symons, G. J.

Evaporation from rain gages. Proc. Brit. met. soc., 1867, 3:408-11.

Comments on Simmonds', 1867, paper of the same title.

Symons, G. J.

Review of Saussure's Essais sur l'hygrométrie. Symons' met. mag., 1867, 2:66-8, 88-90.

See Saussure, 1783.

Symons, G. J.

Evaporators and evaporation. Brit. rainf., 1867, (—):9-10.

Evaporation is declared to be "the most desperate branch of the desperate science of meteorology," owing to the great number and variation in the factors to be considered. For instance, the evaporation from soil involves the nature of the soil and subsoil, the inclination of the ground, the presence or absence of vegetation, the nature of the vegetation, the aspect of the ground, almost every variation in climate, temperature, wind, rain, humidity, sunshine and cloud, the physical characteristics of the district, proximity to the sea, altitude, etc.

He suggests an elaborate plan for comparing evaporation from water, grass growing on clay, grass on sand, grass, corn and roots on the soil of the district, the soil of the district with no vegetation, peat, etc.

Tacchini, P.

Sull' evaporazione osservata in Palermo nel 1865 e 1866. Bul. met. oss., 1867, 3:1-10, 17-19. Translated in Ann. rpt. Smithsn. inst. 1870:457-66.

Evaporation is compared from two atmometers, the Gasparin and the Vivenot, from May, 1865, to December, 1866. Accompanying the table of daily observations with the Vivenot are observations of the monthly average temperature, humidity, and velocity of wind, whence is derived the equation:

$$E=0.20675\,t-0.01517\,H+0.11006\,F,$$

t being the temperature [of the air] in °C., H the humidity in 100ths of saturation, F the hourly velocity of the wind in kilometers. The observed and calculated values of monthly evaporation and their differences are tabulated, also the mean temperature and the mean quantity of rain. A table of seasonal and annual evaporation is added. The annual evaporation was 2¼ times the rainfall.

The actual results from the Gasparin apparatus are corrected by comparison with the Vivenot. A table shows the monthly sine of the sun's altitude, the degree of cloudiness, force of the wind, the daily and monthly evaporation from the Gasparin, the monthly rate from the Vivenot, and the difference. A second equation is derived:

$$E' = 0.20675\,t - 0.06517\,H + 0.2642\,F - 0.0651\,V + 2.9227 \sin h,$$

in which V is the cloudiness exprest in 100ths of the sky obscured, $\sin h$ the sine of the meridian altitude of the sun, and the rest as above. A table of observed and calculated results is followed by a table of mean temperature, mean humidity, $\sin h$, daily evaporation, and total evaporation for the seasons and year. The total evaporation for the year was nearly three times the rainfall and equal to one and one-third that shown in the shade by the Vivenot. Other comparative studies are described, showing the relation between the day and night rates, and the seasonal differences.

Tacchini, P.

Esperienze sui vasi evaporatori. Bul. met. oss., 1867, 3:53–5.

Evaporation from a Gasparin atmometer was compared with that from five glass tubes of different diameters, from June 25 to July 4, 1867. The Gasparin has a surface of 10 square decimeters; the diameters of the tubes were: tube 1 = 28 mm., tube 2 = 20 mm., tube 3 = 10 mm., tube 4 = 8 mm., and tube 5 = 7 mm. The respective amounts evaporated were 1.00, 1.96, 2.13, 1.73, 1.47, 1.28 millimeters.

Tacchini, P.

Sui diametro o larghezza dei vasi evaporatori, e della differenza fra l'evaporazione del giorne e della notte. Bul. met. oss., 1867, 3:65–8. Also in Gior. sci. nat., 1867, 3:65–8.

A comparison of the rates of evaporation from five tubes of different diameters, allowing them to evaporate without refilling after each observation. The table gives the distance of the water surface from the top and the amount evaporated. The rate diminishes as the distance from the top increases and as the diameter of the tube diminishes. A coefficient is deduced by which the normal evaporation for each tube may be determined, supposing the refilling to have taken place. Ratios between evaporation from a Gasparin atmometer and five tubes show little variance at night compared with similar ratios for the daytime, when the ratio is highest between the Gasparin and the tubes of the largest diameter, smallest with those of the smallest diameter. The reason for this result is believed to be the fact that the tubes of large diameter had a higher temperature than those of smaller diameters, even higher than that of the Gasparin.

1868.

Buchan, Alexander.

A handy book of meteorology. Edinburgh. 1868. 2d ed. p. 148–54.

Ebermayer, E.

Aufgabe und Bedeutung der in Bayern zu forstlichen Zwecken errichteten meteorologischen Stationen. Zeits. Oest. Ges. Met., 1868, 3:97–108.

Emphasizes the importance of having at all meteorological stations, comparative observations of evaporation of water in forests and in open places.

Hann, Julius.

Verdunstung des Meerwassers. Zeits. Oest. Ges. Met., 1868, 3:505.

Compares the results of the observations by Chapmann (1855) and Ragona (1867) on the evaporation from salt and fresh water. Chapmann found salt water evaporated only 0.54 as much as fresh water. Ragona in his first experiment found a similar result; but in his second it appeared that the relation varied so much with the temperature and humidity of the air that sometimes the evaporation from salt water exceeded that from fresh water. Neither of these observers gives the strength of the salt solution used.

Henry, D. F.

Tables of evaporation from observations by the Survey of the Northern and Northwestern Lakes. Tables showing comparative readings of evaporators in lake and river, open air and water. Rpt. Chf. Eng., 1868:976–80.

Tables of evaporation and temperature at Milwaukee, Wis., for November, 1861; May–October, 1862; April–October, 1863; April–July, 1864. The mean daily temperature in degrees divided by the mean daily evaporation in inches yields a rather constant ratio between these two factors from which a table is compiled showing the mean daily evaporation in decimals of an inch for each month at Superior, Wis., from 1862–67; at Ontonagon, Mich., from 1861–65; at Milwaukee, Wis., from 1861–67; at Tawas, Mich., from 1861–65; at Thunder Bay Island, Mich., from 1861–65; at Detroit, Mich., from 1861–64; at Monroe, Mich., from 1863–67; and at Cleveland, Ohio., from 1861–67. The evaporators used in the experiments were fully exposed to the sun. A few experiments with one evaporator in the usual position and one floated in the water showed that the lake evaporation is probably not over 64 per cent of that shown by the land instruments. A table compiled according to this correction shows the daily evaporation, the daily amount of rain, and mean temperature at the several lake-survey meteorological stations for the different years. These figures show a somewhat regular relation between the evaporation and the rainfall, the mean being the same for all latitudes. The relation between the mean temperature and the evaporation is still more regular and decreases with the latitude. Another table shows the mean daily evaporation, amount of rain, temperature, latitude and longitude at the several stations, from which is calculated: the daily evaporation from Lake Superior = 0.0486 inch, from Lake Michigan = 0.0617 inch, from Lake Huron = 0.0672 inch, and from Lake Ontario = 0.0642 inch.

Jahn, G. A.

Handbuch der Witterungskunde. Leipsic. 1868. 3d ed.

See Jahn, 1855.

Lamont, Johann von.

Ein neuer Verdunstungsmesser. Repert. der Phys., 1868, 4:197–200. Also Zeits. Oest. Ges. Met., 1869, 4:81–6.

The evaporating cylinder is connected with a reservoir in which slides a piston which can be raised or lowered so as to fill or empty the evaporating dish. The piston is first raised until the water stands at the opening into the evaporating cylinder, and a reading is taken of the water level in the reservoir by means of a scale attached thereto. The piston is then prest back and the dish fills. At the end of the period the piston is raised until the water again stands in the opening, and a reading on the scale is again taken, the difference between the two readings gives the amount of water evaporated. The author recommends the use of this instrument for determining humidity also. In his experiments he finds a greater evaporation from smaller evaporating dishes, but in a constant relation.

Ragona, D.

Osservazioni sulla evaporazione eseguite nel R. Osservatoria di Modena, 1867. Mem. reg. accad. sci. Modena, 1868, 9:186. Also, Modena. 1868. 4to. p. 39.

Symons, G. J.

Evaporation. Brit. Rainf., 1868:(—).

Table of monthly evaporation at Strathfield Turgiss, Hants. Casella's so-called "evaporator" (?), was used with rather unsatisfactory results.

Vogel, K. August.

Ueber den Einfluss des Bodens auf den Wassergehalt der Luft. Sitzber. k. bayer. Akad. Wiss. math. phys. Kl., 1868, 2:497–500.

Reference is made to previous experiments which showed that evaporation is greater from soil without vegetation than from soil with, and that the kind of soil is also an important factor. Further experiments determined (by absorption in sulfuric acid) the amount of water actually present in the air above fallow ground and above that covered with vegetation, showing a higher absolute humidity over the latter.

1869.

Dufour, Louis.

Note sur la différence entre la pluie et l'évaporation observée [pendant 1869] à Lausanne. Bul. soc. vaud. sci. nat., 1869, 10:233–48. Translated in Zeits. Oest. Ges. Met., 1872, 7:113–23. Also quoted and abstracted in Arch. sci. phys. et nat., 1870, 37:243–51. Also abstracted in Quart. jour. roy. met. soc., 1873, 1:112.

Emphasis is here laid on the importance to meteorology of the determination of both rainfall and evaporation. The siccimeter invented by the author measures directly the difference between these two elements. It consists of an open vessel set tightly into the upper portion of a deeper vessel. The former is provided with a vertical tube passing thru its bottom and extending nearly to its rim. The upper vessel is filled with water to the top of the tube and is then allowed to evaporate and collect rain in the open air. If rain fills the upper vessel above the level of the tube water will run over into the lower vessel, and thus any excess of rainfall or evaporation may be determined.

Conditions influencing evaporation are discust and a curve presents the variation in the level of water exposed in the above manner. There is also a résumé of observations from 1865–1868. The approximate mean annual excess of rain is 288 millimeters, the mean annual evaporation is 669 millimeters, the rainfall is 957 millimeters.

Field, Rogers.

Notes on evaporation from a water surface. Being short abstracts of three papers in the Annales des ponts et chaussées. And a note on experiments by Mr. Greaves, at Lea Bridge. Brit. Rainf., 1869 (—): 157–62.

See Ruinet, 1860; Tarbé, 1852; and Vallés, 1850.

Field, Rogers, and G. J. Symons.

On the determination of the real amount of evaporation from the surface of water. Rpt. Brit. assoc. adv. sci., 1869, 39:25–6. Brit. Rainf., 1869 (—): 151–76 (App.). Also Van Nostrand's engin. mag., 1870, 2:143–7. Abstract in Symons' met. mag., 1869, 4:132.

Describes the hook-gage devised by Field and used for measuring the height of water in a tank or reservoir. If the point of the hook is ever so slightly raised above the surface it raises a small cone of water with it which is at once rendered visible by the distortion of the reflection. If, on the other hand, the point is deprest below the water, it carries the water down with it, and forms a depression which also causes distortion of the reflection. It is, therefore, only necessary to adjust the hook so that there shall be no distortion, and the point will then be precisely level with the surface of the water.

Tabulates the rates of evaporation from Casella, Symons, and Phillips evaporators during part of July and August, 1869, at Camden Square, London, together with the temperature of the water in each instrument, also computes the evaporation from the indications of the hygrometer.

Fletcher, Isaac.

Remarks on the rainfall among the Cumberland Mountains, for the years 1865–7, and on evaporation. Brit. Rainf., 1869, (—):36–9.

From a table of the monthly evaporation at Tarnbank, Cumberland, as measured from a gage similar to a rain gage, it is concluded that the rainfall and evaporation for this region are nearly equal, that is, between 46 and 47 inches.

Henry, D. F.

Tables of evaporation from observations by the Survey of the Northern and Northwestern Lakes. Tables showing comparative readings of evaporators in lake and river, open air and water. Rpt. Chf. Eng., 1869:602–5. (Continued from 1868).

The differences between simultaneous readings of an evaporator at the meteorological station and one placed in the St. Clair River, from August 10 to September 14, 1868, are tabulated. The total land evaporation was 4.039 inches, that in the river was 1.997 inches. Similar observations on the Niagara and St. Lawrence rivers gave similar results. The amount of rainfall over the lake and its water-shed, and the ratio between rainfall and outflow in 1868 on Lakes Huron, Superior, Michigan, Erie, and Ontario are tabulated; also the amount of rainfall minus the evaporation from the lake surface, and the ratio between evaporation and outflow at the several stations for each lake in 1868.

Hildebrandsson, H. H.

Historisk redögorelse för de vigtigaste åstigerna on vätskors afdunstning. Tidskr. math. fys., 1869, 2:26–37.

Hosaeus, A.

Die Wasserverdunstung einiger Kulturpflanzen. Ann. Landw., 1869, 53:259–71.

Chiefly a study of transpiration from different crops, with some consideration of evaporation from soil.

Lamont, J. von.

Verschiedene Einrichtungen des Verdunstungsmessers. Münch. Stern. Wochenbl., 1869:234–5. Also Repert. der Phys., 1870, 6:113–6.

Different methods of measuring evaporation are described. One form of instrument consists of two reservoirs, one closed the other open, connected at their bases by a graduated tube containing an air bubble. As water evaporates from the open dish, the air bubble changes position, and the difference in readings on the scale gives the amount of evaporation.

Lamont, J. von.

Bemerkungen über das Messen der Wasserverdunstung in freier Luft. Zeits. Oest. Ges. Met., 1869, 4:241–6.

Gives the details of further experiments comparing evaporation from water in dishes of different sizes. Repeats the table given in Lamont, 1868. Advises experiments to compare evaporation in different exposures. Suggests the use of the atmometer as a psychrometer, as it determines the average humidity for any given period, an advantage over the usual method which only determines it for momentary periods.

Marié-Davy, H.
Atmidomètre à vase poreux de Babinet. Nouv. mét., 1869, **2**:253-4.

This atmometer consists of a porous vessel, similar to those used in ordinary electric batteries, closed by a stopper bearing a glass tube of small bore which leads to a copper cylinder, furnished laterally with a vertical glass tube graduated in millimeters. The porous vessel is filled with water and remains filled by capillarity, in spite of the evaporation which operates at its surface, and although the level of the water in the reservoir is lower than the evaporating surface. The section of the supply reservoir is only 0.0379 of the evaporating surface; this ratio can be varied at will. An extreme sensibility is claimed for this instrument, together with the possibility of following from hour to hour the progress of evaporation, and of obtaining at a given hour and day the effect upon it of temperature, the state of the sky, the movement and humidity of the air, etc. It is regarded as an apparatus suitable for experimentation rather than an instrument able to remain for a long time comparable to itself. Unless it is supplied with distilled water, calcareous salts dissolved in the water gradually incrust the pores and destroy the permeability of the clay, which may be restored by washing with a very weak solution of acetic acid. Gives a table showing the hourly rate for July 7-8. When the pores are free evaporation from this surface is found to be almost as rapid as that from a free water surface, taking into account the temperature of the evaporating water. Evaporation is proportional to the difference between the actual tension of water vapor in the air, and the vapor tension of saturated air at the temperature of the evaporating surface. The temperature of the porous surface is lower than that of the surface of freely exposed water, because in the latter case the evaporating surface is warmed by diffusion from the main body of water, while in the former diffusion is very slow. In one afternoon the porous vessel evaporated 1.584 mm. at a mean temperature of 27.6° C., while an ordinary atmometer lost 2.844 mm. at a mean temperature of 33.5° C.

Risler, Eugène.
Sur l'évaporation du sol. Arch. sci. phys. et nat., 1869, **36**:27-33. Also summarized in Proc. inst. civ. engin., 1876, **45**:56.

Experiments were made at Calève, near Nyon, Switzerland, with drain gages 1.2 meters deep containing a compact and impervious subsoil. The average annual rainfall, 1867-8, was 41 inches, 70 per cent of which evaporated, and 30 per cent percolated into the ground.

Symons, G. J. and Rogers Field.
See Rogers Field.

Symons, G. J.
Evaporation. Brit. Rainf., 1869, (—).

Tables compare results of evaporation observations with various atmometers, which are described. They generally consisted of vessels, more or less protected from overheating, for determining the amount lost from a free water surface. Those of Beverly, Buist, Casella, Dalton, Dines, Greaves, Howard, J. F. Miller, S. H. Miller, Mitchell (bird-fountain device), Proctor, Sharple, Steinmetz, are of this form.

1870.

Ansted, D. T.
Physical Geography. 1870. 4th ed. p. 285-6. Abstract in Ramsay, 1884.

Refers to the enormous force consumed in the evaporation of water from the ocean. Estimates total annual rainfall of the earth at not less than 200 millions of millions of tons. Assuming the evaporation to be equal to the rainfall, an average of about 7,000 pounds of water evaporate every minute from each square mile of ocean surface. "The conversion of this into vapor, conveyance thru the air, and recondensation means a force equivalent to the lifting of very much more than 1,500,000 millions of millions of pounds of water one foot high per minute of time during the whole period." This does not include the large evaporation from the land surfaces of the earth.

Dines, George.
Evaporation. Symons's met. mag., 1870, **5**:70-2. Review in Brit. rainf., 1889, (—): 24-5.

Compares the rates of evaporation from five evaporators of different sizes, the largest 1¼ feet in diameter, and finds the largest lost less than ⅘ of the amount lost by the smallest. The temperature of the water in the largest evaporator varied from 32° to 77° in April, while the river temperatures varied from 39° to 60.3°; in June the temperature of the former varied from 33° to 84°, but the river varied only from 46° to 66.8°. The influence of temperature upon the rate of evaporation is shown by the following observation: "In a room of which the temperature was 62°, water of that temperature evaporated at the rate of 0.003 inches per hour (about 26 inches in a year), and water at 88° evaporated at the rate of 0.015 inches per hour (about 131 inches per year)."

Dines, G[eorge].
On evaporation and evaporation gages, with some remarks on the formation of dew. (1870.) Short abstract and note in Nature, 1870, **3**:79; Proc. Brit. met. soc., 1871, **5**:199-213.

Experiments in evaporation from water at temperatures below 176° F. showed that evaporation goes on until the temperature of the water, falling lower than that of the air, approaches the dew-point; that condensation occurs at temperatures of 32° and higher until the dew-point is again approached. The dew-point thus indicates very closely the line of demarcation between evaporation and condensation. Dalton's formula, $Dx=E$ (where D is the vapor pressure in inches of mercury at the temperature of the water minus that at the dew-point, and x is a constant determined by experiment), is considered approximately correct when water temperature and dew-point are far apart, but uncertain when these temperatures closely approach each other. Experiments showing the influence of heat are described, together with others in which the depth of the water below the edge of the vessel exerted considerable influence on the amount of evaporation. Evaporation from sea water amounted to 4¼ per cent less than that from rain water, and this difference increased with increasing concentration.

Dufour, Louis.
Observations siccimétriques à Lausanne. Bul. soc. vaud. sci. nat., 1870, **10**:555-6. Also Les mondes, 1873, **31**:570-2. Also Bul. int. obs. Paris, June 17-18, 1873; Mar. 26-27, 1875. Also conclusions in Arch. sci. phys. et nat., 1870, **37**:245; 1875, **52**:241-3; 1875, **53**: 129-31.

The siccimeter described in Dufour, 1869, showed almost equal rainfall (855 millimeters) and evaporation (860 millimeters) in 1869.

[*To be continued.*]

CORRIGENDA.

In MONTHLY WEATHER REVIEW for March, 1908, Vol. XXXVI, p. 53, column 1, line 25, for "drained" read "dredged."

In MONTHLY WEATHER REVIEW for April, 1908, Vol. XXXVI, p. 109, the equations (17), (18), (19), and (20) should read as follows:

$$F_0'=Q_0\left[(0.061-0.008\delta)+0.0012E_0m\right] \qquad (17)$$

$$Q_m=Q_0\left(\frac{0.93^{m\delta}}{1+0.18m\delta^{1/2}}-\left[(0.061-0.008\delta)+0.0012E_0m\right]\right) \qquad (18)$$

$$\frac{Q_{m+1}}{Q_m}=\frac{\dfrac{0.93^{\delta(m+1)}}{1+0.18(m+1)\delta^{1/2}}-\left[(0.061-0.008\delta)+0.0012E_0(m+1)\right]}{\dfrac{0.93^{m\delta}}{1+0.18m\delta^{1/2}}-\left[(0.061-0.008\delta)+0.0012E_0m\right]} \qquad (19)$$

$$Q_0=\frac{Q_m}{\dfrac{0.93^{m\delta}}{1+0.18m\delta^{1/2}}-\left[(0.061-0.008\delta)+0.0012E_0m\right]} \qquad (20)$$

In MONTHLY WEATHER REVIEW, for June, 1908, Vol. XXXVI, p. 177, Table 1, column headed "No. days and mo. in which temperature fell to zero," make it read "fell *below* zero."

In MONTHLY WEATHER REVIEW for August, 1908, at bottom of page 239 and top of page 240, the headings to tables should read "Dates of opening and closing of navigation at the more important ports on Lake Superior." On page 241, top of page, omit "continued" from table heading.

For August, 1908, page 249, column 2, line 2, for "Table 49" read "Table 50." Page 235, column 2, line 21 from the bottom should read "the rise usually comes earlier, . . ."

In MONTHLY WEATHER REVIEW for September, 1908, page 285, column 2, line 18, for "the sum of all the radiation" read "the sum of all the diffusely reflected radiation." Page 285, column 2, line 20, insert "radiation" at the end of the line, to read "the total amount of solar radiation which falls on *a*." Page 286, column 1, line 21, the expression

$$\frac{1}{0.994\left[\varphi(Z)+\varphi(i)\right]} \text{ should read } \frac{1}{0.994^{[\phi(Z)+\phi(i)]}}.$$

Page 299, columns 1 and 2, and page 300, column 2, for "Hellman" read "Hellmann." Page 306, column 2, last line, insert (to be continued).